with the epidemic should come to the United States Public Health Service only through the State health officer. Moreover, as soon as possible all this epidemic work was organized on State lines, with a representative of the United States Public Health Service detailed to each State to secure the best possible organization and coordination of health activities of the service; in others the executive of the State board of health has been given appointment in the United States Public Health Service as field director.

With the extension of the epidemic and the increasing demands made on the Public Health Service, welcome aid in securing physicians was furnished by the American Medical Association and by medical journals and newspapers which published appeals to physicians to offer their services. As a result, the Public Health Service now (Oct. 22) has over 600 physicians and 50 miscellaneous employees (nurses, clerks, stenographers, etc.) on duty in various States. This does not include the nurses and nurses' aids serving under the Red Cross.

While the activities of the doctors and nurses working under the Public Health Service are generally limited to those ordinarily regarded as preventive health measures, emergency conditions in some communities have been such that much medical relief work has had to be undertaken. This was the case, for example, in several communities where the few practicing physicians were themselves stricken and where the people were in urgent need of medical attention.

While the epidemic is subsiding along the Atlantic seaboard, it appears to be increasing in prevalence in the Central States. Physicians and nurses are therefore still needed. The latter should apply to their local Red Cross chapter, which will attend to their enrollment and assignment to duty. Physicians who are ready to undertake service in the United States Public Health Service should communicate directly with the bureau representative in their respective States. Address United States Public Health officer in charge, care of State board of health.

PRELIMINARY REPORT ON CARBON TETRACHLORIDE VAPOR AS A DELOUSING AGENT.

By M. H. FOSTER, Surgeon, United States Public Health Service.

The effectiveness of dry and moist heat and hydrocyanic acid gas as a means of destroying body lice on clothing has been thoroughly investigated. These processes, while effective, require the use of somewhat complicated apparatus, which is not easily transported and not always available for troops in actual warfare. Also, in civilian life the problem of cleaning up lousy clothing without special

appliances occasionally presents itself in jails, small hospitals, asylums, camps, and even the home.

In the search for some practical method of destroying lice which could be applied with simple apparatus and which would not injure woolen fabrics, the writer was led to investigate the effects of carbon tetrachloride vapor.

Carbon tetrachloride is a heavy, colorless fluid, with a slight fruity odor, and is extensively used in fire extinguishers, as a solvent for many substances in the arts, and also as the chief constituent of certain proprietary cleansing fluids on account of its great power to dissolve fats. The vapor of carbon tetrachloride is heavy and instantly extinguishes combustion. As an insecticide it has not attracted much attention, but it appears to be very toxic for flies, ants, potato bugs, and lice.

The effect of carbon tetrachloride vapor was contrasted with that of gasoline and chloroform in regard to its effect on flies. The vapor of carbon tetrachloride was found to be much more toxic to these insects than either of the other two.

The pure vapor killed unprotected lice in 15 minutes but failed to destroy them in 10 minutes.

The effect of the combination of gasoline and carbon tetrachloride vapor was determined, the proportion being 1 part of gasoline to 2 parts of carbon tetrachloride. The vapor from this combination was not inflammable, but the mixture was by no means as efficient as the same amount of carbon tetrachloride.

Having in view the delousing of soldiers' clothing in places where complicated apparatus could not be obtained, after a number of preliminary experiments the following method was thoroughly tested:

A 10-gallon tin can, such as is used for shipping liquid disinfectants, was obtained. This can was 12 inches in diameter, 19 inches high, sheathed with a light wood covering, and weighed 5½ pounds. The top was cut out so that clothing could be introduced and removed readily. In making the tests the complete clothing of a United States Army private, consisting of hat, olive-drab woolen blouse, olive-drab woolen breeches, leggins, socks, woolen underdrawers, woolen undershirt, and olive-drab woolen shirt, was placed in this can, each article being fairly firmly rolled up. A soiled shirt, badly infested with lice, was cut into four pieces. Each piece of the shirt was rolled fairly tightly and then further wrapped in 10 thicknesses of ordinary sheeting. One piece of this material containing 90 live lice was lightly wrapped in the olive-drab breeches and placed near the bottom of the container, another holding 98 live lice was tightly wrapped in the middle of the blouse and packed near the top of the contents. The complete outfit of wearing apparel was placed in

the tin and pressed down rather firmly, occupying a little more than one-half of the total space. Several layers of filter paper were laid on top of the clothing, and on this paper 25 c. c. of carbon tetrachloride was poured. The top of the can was covered by several thicknesses of toweling and a loose cover placed over this, the idea being to protect can from the effects of drafts but not to seal it hermetically so as to permit some of the air to escape at the top when it was displaced at the bottom by the heavy vapor. At the end of two hours the can was opened, the package containing the lice-infested shirt was aired and examined. All the lice were found to be dead and they did not revive when examined at various periods up to 24 hours afterwards. It was ascertained that exposure, under similar conditions, to the same strength of carbon tetrachloride for an hour and a half was not sufficient to kill all the lice, about 25 per cent surviving. It was also found that a lesser amount of carbon tetrachloride was not sufficient to kill the lice in two hours.

These experiments were repeated in various ways with lice on pieces of cloth contained in test tubes open at both ends but fairly tightly sealed with cotton plugs. These tubes were tightly wrapped in all the various articles of clothing, and it was found that 25 c. c. of carbon tetrachloride, with exposure of two hours, was sufficient to kill all the lice.

The garments were hung up and aired for an hour, after which no odor of carbon tetrachloride could be detected on them.

Various emergency devices could undoubtedly be used to replace, if necessary, the tin container which was bought on the open market at retail for $1. A large galvanized iron bucket was very successfully used, provided it was not filled quite to the top.

It is essential that the container should be air-tight, that it be only two-thirds full of clothing, and it should be about twice as high as it is broad, as the vapor appears to be easily disseminated from shallow or broad receptacles. A muslin or canvas bag coated with rubber would probably give similar results if it were air-tight. Vulcanized rubber is somehwat softened by the vapor but afterwards assumes its natural state. It might be possible to utilize an ordinary rubber blanket, if it were properly folded, to prevent the escape of the heavy vapor.

Wrapping the clothing up in heavy paper was tried, but this was not successful, as the heavy gas apparently leaked rapidly through the pores of the paper.

The outfit of soldier's clothing mentioned above, when rolled up and stowed in the can, occupied 1,134 cubic inches of space. Taking 25 c. c. of carbon tetrachloride as furnishing sufficient vapor to kill all lice on this amount of clothing, the following table, showing the

amount of the chemical required for different standard units of space, has been constructed:

Space occupied by clothing.	Amount of carbon tetrachloride required with 2 hours' exposure.
	c. c.
100 cubic inches	[1] 2
231 cubic inches (1 gallon)	4.5
1 cubic foot	30.5

[1] 1.82 c. c. exactly.

Carbon tetrachloride is difficult to obtain on the open market at the present time as the Government has requisitioned all available supplies for war purposes. When a Federal permit can be obtained for its use, it is quoted at from 14 to 18 cents per pound in 1,400 pound drums. A pound contains about 290 c. c.

At 18 cents a pound the cost of treating the amount of clothing previously enumerated would be about 1½ cents. In winter time the extra underwear, blankets, overcoat, sweater, etc., would make a total of somewhere between 4,000 and 5,000 cubic inches and the expense of delousing the entire outfit about 5 cents per man. In small lots the chemical is now sold at 37 cents per pound.

The tests were made at temperatures ranging from 68° to 72° F. It is to be inferred that the results would not be as good at lower temperatures and further work along this line is desirable. However, the temperatures prevailing at the time the tests were performed were approximately those of artificially warmed living habitations even in winter.

The experiments made to determine the power of carbon tetrachloride vapor to kill the ova of the body louse have not been completed. It was definitely determined, however, that the nits are not killed by treatment with 30.5 c. c. of carbon tetrachloride to the cubic foot of space, with two hours' exposure. One test using 150 c. c. of the chemical to the cubic foot prevented the eggs from hatching after eight hours' exposure but a few of them hatched after four hours' exposure. No opportunity has offered as yet for confirming this result.

In considering the applicability of carbon tetrachloride as a delousing agent, the possible danger to human life must be borne in mind. The substance is said to be slightly more poisonous to human beings than chloroform. Several deaths have been reported among hairdressers and their subjects, when this substance was used for cleaning the scalp. This was apparently due to inhaling the fumes in a concentrated form. The fact that carbon tetrachloride is the

base of one of the widely advertised cleansing fluids for removing grease spots from the clothing, would seem to indicate that its use in the hands of the laity is not accompanied by any grave danger. Inhalations have been employed for relief of various sorts of pain, but it was found to be more depressing to the heart than chloroform. It has been injected subcutaneously in doses of from 10 to 20 minims.

If experience shows that it is safe to use this substance in the manner described for the destruction of body lice on woolen fabrics, it will certainly prove to be a most efficient and convenient means of killing lice on the clothing of troops or civilians in places where recourse can not be had to more complicated methods, as all that is necessary in actual practice is to place the infested articles in the container, pour the required amount of carbon tetrachloride on the top layer, cover and allow the can to remain undisturbed for two hours, after which they are properly aired.

In reporting this investigation of carbon tetrachloride as a louse destroyer, it is not contemplated to propose it as a substitute for the heat or cyanid gas treatments where these are available, as they would certainly be much more economical where large bodies of men are to be deloused at one time and in one place.